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INDO-PACIFIC FISHERY COMMISSION

Report of the

THIRD SESSION OF THE INDO-PACIFIC FISHERY COMMISSION WORKING PARTY OF EXPERTS ON INLAND FISHERIES

Bangkok, Thailand, 19-27 June 1986

and

Report of the

WORKSHOP ON STRATEGIES FOR THE MANAGEMENT OF FISHERIES AND AQUACULTURE IN MANGROVE ECOSYSTEMS

Bangkok, Thailand, 23-25 June 1986

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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Rome 1986

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PREPARATION OF THE DOCUMENT

This document is the final version of the report adopted on 27 June 1986 by the participants at the Third Session of the Indo-Pacific Fishery Commission Working Party of Experts on Inland Fisheries, which met in Bangkok, Thailand, 19 - 27 June 1986. It also includes the Report of the Workshop on Strategies for the Management of Fisheries and Aquaculture in Mangrove Ecosystems, held in Bangkok, Thailand, 23-25 June 1986.

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ABSTRACT

This document presents a review of the activities in inland fisheries during the intersessional period 1984-1986, and the results of discussions during the Third Session of the IPFC Working Party on Inland Fisheries, which met in Bangkok, Thailand, 17 to 27 June 1986. It also includes the Report of a Workshop on Strategies for the Management of Fisheries and Aquaculture in Mangrove Ecosystems, which met during the Third Session of the Working Party. Edited country status reports on inland fisheries and papers presented during the Workshop are issued as a supplement to this report.

CONTENTS

		Page
Recommendations of the Third Session of the IPFC Working Party of Experts on Inland Fisheries		1
Summary of the follow-up activities as proposed for the next intersessional period		3
Report of the Third Session of the IPFC Working Party of Experts on Inland Fisheries		6
Workshop on Strategies for the Management of Fisheries and Aquaculture in Mangrove Ecosystems		22
Annex A.	Agenda	27
Annex B.	List of Participants	28
Annex C.	List of species suitable for introduction and stocking of the IPFC lakes, reservoirs and smaller waterbodies	30
Annex D.	Selected technical papers, circulars and reports with relevance to the IPFC region inland fisheries, published by FAO	31
Annex E.	Development of China's reservoir fisheries, by Xiangke Lu	32
Annex F.	Pelagic fish in Ubolratana reservoir, by Oopatham Pawaputanon	34
Annex G.	Conservation of genetic resources of fish	36
Annex H.	The EIFAC Code of Practice	39
Annex I.	Papers submitted to the Workshop on Strategies for the Management of Fisheries and Aquaculture in mangrove ecosystems	42

RECOMMENDATIONS OF THE THIRD SESSION OF THE IPFC WORKING PARTY OF EXPERTS ON INLAND FISHERIES

The Working Party of Experts on Inland Fisheries recommended that:

1. Inland fisheries and agriculture legislation, rules and regulations in existence in IPFC countries be collated and published in order to serve as a reference tool in the formulation of specific country guidelines for planning for fisheries and aquaculture, especially for the multiple-use of resources; (Attention: FAO Division of Policy and Planning).

2. Fisheries management of IPFC waterbodies by stocking common and Asian major carps be reviewed and the information assessed especially in regard to the performance of these carps vis-a-vis other fish species assessed; (Attention: India, China).

3. A review be prepared on pelagic fish of inland waters in the IPFC region, including their current exploitation and potential; (Attention: India, Thailand and the Philippines).

4. Activities in the field of conservation of genetic resources of fish in the IPFC member countries be closely monitored and that active support by providing information on the fisheries needs be given by the members of the Working Party as well as the Secretariat. Attention of government fishery bodies should be drawn to the existence of the "Code of Practice to reduce the occurrence of adverse effects arising from the transfer or transplant of aquatic organisms", as adopted by EIFAC, and its potential for acceptance in the IPFC member countries be assessed. (Attention: member countries, Secretariat).

5. Pakistan (i) provides a detailed account of its experience on migration of individual fish species through fish ladders of the Chashma Barrage; (ii) investigates possibility of close collaboration between fisheries experts with dam/barrage/irrigation engineers for improving such constructins or designing new systems for transporting fish over dams and barrages; (iii) communicates this information to the Secretariat for further evaluation and dissemination. Australia may provide additional information on this problem; (Attention: Pakistan, Australia, Secretariat).

6. Communications be improved at international and national levels on mangrove ecosystem management from the point of view of fisheries and aquaculture, existing links at international level as well as national level be further strengthened, and wherever possible, international collaboration be extended to other international organizations and to internal technical assistance agencies; (Attention: Secretariat, member countries).

7. IPFC Working Parties on Inland Fisheries and Aquaculture assume responsibility for periodic updating of research and development advances in mangrove management for fisheries and aquaculture respectively at their session; (Attention: member countries).

8. Literature review is undertaken to determine the compatibility of forestry and other sustainable uses with fisheries and agriculture, to be followed up by a review of sustainable uses of the mangrove ecosystem on a country by country basis in the Indo-Pacific region; (Attention: Secretariat).

9. FAO disseminates information on the restoration of mangroves and seagrasses, and investigates the possibilities for TCDC; (Attention: Secretariat).

10. FAO prepares guidelines for the siting of aquaculture in mangroves; (Attention: Secretariat).

SUMMARY OF THE FOLLOW-UP ACTIVITIES AS PROPOSED FOR THE NEXT INTERSESSIONAL PERIOD

The Secretariat has been requested to coordinate and assist with the following activities in capture fisheries:

1. Biology

   - dissemination of breeding technology for mahaseer (RAPA);
   - monitoring activities in the region on conservation of fish genetic resources (individual countries to report to the Secretariat);
   - provision of advisory assistance on maintaining genetic quality of fish resources (Secretariat);

2. Reservoir and lake research management

   - compilation of a list of suitable fish species for stocking IPFC lakes and reservoirs, including those of cold waters (in progress);
   - simple models for prediction of fish yield from ponds, reservoirs and lakes of the IPFC region, to be produced in a form of a manual (Secretariat);

3. River and floodplain fisheries

   - monitoring of activities on floodplain stocking, as planned for or being undertaken by several countries of the region; (Secretariat, in close collaboration with individual countries);
   - Hilsa fishery investigations, especially in Pakistan (subject to request from Pakistan);
   - organization of training programmes on the identification of mountain stream fish fauna (NACA);
   - assistance with the evaluation of structures assisting fish migrations (Secretariat);
   - to look into the possibility of an overall coordination of activities on fish stock enhancement in mountainous regions of the Karakoram/Himalaya region, by establishing a sub-regional project (Secretariat);

4. Mangroves

   - production of compendium of mangrove associated species of economic importance (Secretariat);
   - data base search on organisms of economic importance associated with seagrasses and on seagrass management;list to be distributed to Working Party members (Secretariat);
   - literature review to determine the compatibility of forestry and other sustainable uses with fisheries and aquaculture (Secretariat);

- dissemination of information on the restoration of mangroves and seagrasses to countries of the IPFC region (Secretariat);

- preparation of guidelines for the siting of aquaculture in mangroves (Secretariat).

5. Marketing

- preparation of a global study of the long-term outlook for foreign exchange earning fish and seafood commodities produced by IPFC countries (for consideration by the Fishery Industries Division);

6. Planning and legislation

- collation of the existing rules and regulations in IPFC countries as a reference tool for the formulation of specific planning guidelines, on a country basis (for consideration by the Fishery Policy and Planning Division);

7. Training

- compilation of a list of established inland fishery and aquaculture training opportunities in the IPFC Region (Secretariat, with close collaboration with RAPA and member countries);

Activities addressed for attention and action of the IPFC member governments:

1. Biology

- review of use of floating aquatic plants to enhance fish production (China);

2. Reservoir and lake research management

- the need for synthesis of available information on performance of carps vis-a-vis other fish species (India and China);

- the need for collation of information on the existing pelagic fish of inland waters in the IPFC Region (India, Thailand, The Philippines);

- evaluation of stocking success with Macrobrachium in polyculture with fish (Thailand, Sri Lanka);

- review study of simple models for predicting fish yields from ponds, reservoirs and lakes of the region (India).

3. River and floodplain fisheries

- assessment of the efficiency of the existing fish ladders for fish migration and suggestions for improvement of such structures (Pakistan, Australia).

4. Pollution and environment

- review of integrated aquaculture with crop and animal agriculture, and on biogas slurry as direct fish feed (India);

- case studies on successful management of aquatic plants to enhance fish production (China).

5. Mangroves

- periodic updating of research and development advances in mangrove management for fisheries and aquaculture (Members of the Working Party);

6. Planning and legislation

- the need for pilot trials prior to introducing combination of aquaculture with capture fisheries, to avoid conflicts (attention of all goverments).

In the field of aquaculture, the Working Party expressed the need for:

- regional engineering training course;

- production of video-cassettes and publication of aquaculture technologies, methods and techniques, especially on fish seed production;

- assistance in seed production;

- national fish disease diagnostic centres which could provide quick service to aquaculturists;

- more attention to be paid in future to genetic resources of fish;

- revival of the FAO Aquaculture Bulletin for rapid dissemination of aquaculture information throughout the region.

The Working Party put forward two proposals for a special topic for the next combined IPFC Working Parties on Inland Fisheries and Aquaculture meeting:

- Management of waterbodies in the IPFC Region and China by using common and Asian major carps;

- Conservation of fish genetic resources in the IPFC Region.

The Working Party concluded the Third Session with a firm hope that the next session takes place in two years time, with the Working Party on Aquaculture Session in tandem, and with a joint Workshop for both Working Parties to allow for discussions on aspects of common interest.

REPORT OF THE THIRD SESSION OF THE IPFC WORKING PARTY OF EXPERTS ON INLAND FISHERIES

The Working Party was convened from 19 to 27 June 1986 in Bangkok, Thailand. The first three days of the meeting were devoted to the aspects of inland fisheries. This was followed up by Workshop on Strategies for the Management of Fisheries and Aquaculture in Mangrove Ecosystem (23-25 June). The Working Party concluded its session by two days of discussion of aquaculture (26-27 June). Mr. A.Q. Chowdhury, Director, Department of Fisheries, Government of Bangladesh, was unanimously elected Chairman of the Working Party. For Agenda and List of Participants, see Annexes A, B and C.

IMPLEMENTATION OF THE PROGRAMME SINCE THE SECOND SESSION OF THE WORKING PARTY (New Delhi, India, 23-27 January 1984)

(a) Reservoir research and management

(i) Information on fish species suitable for stocking in lakes and reservoirs in the IPFC Region has been received by the Secretariat from Australia, India, Indonesia, Nepal, Philippines, Sri Lanka and Thailand. Additional material is expected to be received during the next intersessional period, so as to enable publication of the inventory in time for the next meeting. For the list of species currently available see Annex D.

(ii) The suitability of local species for stocking of cold water is being studied in India and Nepal where some indigenous coldwater species are now known to have good potential for stocking in reservoirs and lakes.

(iii) Simple predictive models for fish yields from ponds, reservoirs, and lakes in the IPFC region: no progress.

(b) Management

Although no training courses in reservoir fisheries management have yet been organized under a TCDC scheme, India has been conducting courses for international students in this field at the CIFE in Bombay. The National Inland Fisheries Institute in Thailand has also organized short-term (six-week) training courses at Ubolratana Reservoir under the Thai Aid Programme.

(c) River and floodplain fisheries

(i) No activity was reported to the IPFC Secretariat on the elaboration of statistical sampling systems for estimating fish catch from rivers.

(ii) Two consultants - one for the USSR and another for Latin America - have been commissioned by FAO to review structures assisting migration of non-salmonid stocks. The results of their studies should be published by FAO early next year.

(iii) A Fisheries Technical Paper (No.262) on River Fisheries (by R.L. Welcomme) was issued by FAO in 1985. This deals with rivers of the IPFC Region as well as other rivers of the world.

(d) Biology

Synopses on a number of economically important species are now in varying degrees of preparation: India is compiling synopses on Anabas, Heteropneustes, Clarias, Labeo, and Tor, and some progress has also been made in Australia in the preparation of Lates calcarifer. Sri Lanka continues with the preparation of synopses on Etroplus suratensis and Labeo dussumieri. Nepal volunteered to prepare a synopsis for Schizothorax spp.

(e) Mangroves

The Workshop on Strategies for the Management of Fisheries and Aquaculture in Mangrove Ecosystem was held in Bangkok, Thailand, 23-25 June 1986, during the Third Session of the IPFC Working Party of Experts on Inland Fisheries.

(f) Statistics and data

As the Working Party on Statistics has been dissolved, it could not assist in statistical data evaluation and methodologies. The FAO Fisheries Technical Paper No.202 on River Basins (by R.L. Welcomme) has a good section on statistical systems, which could be used as a starting point for the development of suitable data collection methodology for the IPFC countries.

(g) Publications

(i) A provisional list of inland fisheries and aquaculture specialists in the Indo-Pacific Region has been compiled by the Secretariat and published as FAO Fisheries Circular C796 using information provided by the individual countries.

(ii) A number of fisheries technical papers and circulars has been prepared during the intersessional period and published by FAO (See Annex E).

(iii) There has been no progress in the establishment of international journal for publication of inland fisheries-related scientific papers from the Region.

(h) An Expert Consultation on Inland Fisheries of the Larger Indo-Pacific Island Countries is to be held 4 to 9 August 1986 in Bangkok, Thailand.

IMPLEMENTATION OF RECOMMENDATIONS FROM JOINT DISCUSSIONS WITH THE IPFC WORKING PARTY ON AQUACULTURE

Action has been taken on a number of recommendations proposed at the last meeting.

(a) Planning for fisheries and aquaculture

(i) Three case studies of fisheries in integrated river basin development - one for the Philippines, one for Sri Lanka and one for Thailand were prepared by consultants and published by FAO as Fisheries Technical Paper T265.

(ii) Two papers reviewing inland fisheries under constraints from other users of the resource have been prepared, one for the

Indian subcontinent and Sri Lanka, and general considerations and the Philippines, respectively (FAO Fisheries Circulars C797 and C798), for use as basis for the formulation of guidelines on fishery development under specific situations.

(b) Development of aquatic areas of marginal value for aquaculture

(i) Two proposals for development of marginal areas for aquaculture submitted by FAO to international agencies for funding, failed to obtain their support.

(ii) In India, Sri Lanka, and Thailand, derelict areas, and seasonal and village tanks have been recently receiving more attention from their respective governments and have become the beneficiaries of loans from the Asian Development Bank and the World Food Programme.

(c) Pollution and environment

(i) Information on the water requirements of aquaculture and fisheries downstream of the dam, has been scanty. No specific progress has been reported.

(ii) A review of the state of water pollution affecting inland fisheries in Southeast Asia was prepared by a consultant and published as FAO Fisheries Technical Paper T260.

(iii) Studies on the use of organic wastes for aquaculture: several countries such as India and China have achieved some progress and it has been proposed that they provide information on this subject to the Secretariat for compilation.

(d) Infestation by aquatic weeds

A consultancy has been commissioned by FAO to review for the IPFC Region the interrelationships between aquatic weeds, fish and fisheries.

DISCUSSIONS OF THE WORKING PARTY ON INLAND FISHERIES

Country Status Reports presented by participants, concentrated on the major intersessional activities and achievements of each country. For their full text see Supplement 1 of this Report. This was followed by a discussion which was arranged under several major headings as follows:

(a) Planning for fisheries and aquaculture

A number of countries (e.g. India, Sri Lanka, Philippines) reported that inland fisheries are now paid considerable or full attention during the planning for multipurpose development projects. Nepal is taking measures to prevent further degradation of watershed areas by reforestation as a step towards improving the water quality in rivers and recipient lakes and reservoirs. It was noted that efforts of the IPFC Working Party and the Secretariat in promoting the interest of fisheries in reservoir planning, have been successful.

Although fisheries have never been a primary purpose of reservoir development, an increasing number of cases shows that benefits from fisheries can yield socio-economic returns to families inhabiting the

lakeshore areas and improve considerably the balance sheet of running some reservoirs, as documented in China and Thailand.The Working Party members should intensify their efforts in drawing the attention of the governments of the IPFC countries and China to the possible social, economic, and financial benefits that could be derived from development of the fisheries in resource development projects, such as in reservoirs constructed primarily for irrigated agriculture and/or hydroelectric power production. The example of Ubolratana reservoir in Thailand was used to illustrate that benefits from fisheries could even exceed those from power generation, the primary purpose of this reservoir.

The Working Party suggested that inland fisheries and aquaculture legislation, rules and regulations in existence in IPFC countries would be a useful reference tool in the formulation of specific guidelines on a country basis and recommended that the Secretariat requests the FAO Division of Policy and Planning to assist in collation of such documents.

(b) Reservoir and lake research and management

(i) Small reservoir and lake fisheries development combining aquaculture practices with capture fisheries: While small waterbodies such as reservoirs, tanks, and small lakes abound in the Region, relatively little is known about their physicochemical and biological features and therefore their potentials for increased fish production and the possible socio-economic benefits that could be derived from their enhanced utilization. It was noted that before a suitable management approach could be determined for a particular lake or reservoir, certain basic information and data would need to be collected. There is a need for an inventory of such waterbodies, based on their typological classification, and for assessment of current fish stocks and fishery practices, including estimates of present yields and potentials for further production increase by using stocking and aquaculture practices.

Successful approaches using intensive stocking and cage or pen culture have been developed, for example in China and the Philippines. The 'stock-and-take' approach is commonly applied to a number of Chinese reservoirs, and a novel approach for utilising reservoir coves for fingerling production has been reported (see Annex F). A number of countries reported a great increase in seed production using Chinese-type hatcheries, enabling them to produce increasing numbers of fingerlings for reservoir stocking, and hence, for increasing reservoir fish production. However, combination of aquaculture with capture fisheries may lead to conflicts, and the Working Party has recommended that attention of the member governments be drawn to the need for pilot trials and experiments on such schemes before their implementation on a large scale. Social impacts, costs and benefits of such undertakings, should also be looked into.

(ii) Fisheries management of IPFC waterbodies by stocking of carps: While carps (Chinese and Indian major carps and common carp) are widely used to stock lakes and reservoirs in the Region, mainly on account of their acceptability and high market value, there is a need to review the current use of carps in the different

countries of the IPFC Region and China. The Working Party recommended that India and China, the most advanced countries in this field, synthesize the available information especially in regard to the performance of these carp vis-a-vis other fish species, and make it available for the next session of the Working Party on Inland Fisheries for further discussion. The Secretariat has offered to provide assistance with the preparation of these syntheses. It has also been suggested that the management of waterbodies in the IPFC Region and China by using carps would be a suitable topic for a joint Workshop of the future sessions of IPFC Working Parties on Inland Fisheries and on Aquaculture.

(iii) Small pelagic fish in inland waters: In some lakes and reservoirs of the Region, small pelagic fish have contributed significantly to the total fish standing stock. However, in Thailand for example, pelagic species have not been accepted as food due to their small size and their importance lies mainly in increasing lake and reservoir fish yields by serving as prey for commercially important, high-order species. The role of Corica sp. in promoting the increased production of the carnivorous mudfish Ophiocephalus striatus in Thailand's Ubolratana Reservoir, was mentioned (Annex G). The fish composition of the pelagic niche, especially in larger lake/reservoir ecosystems, is still poorly known and hardly utilized by the fisheries. It is probably also a major niche which could be occupied by suitable introduced species. There is a great need for a critical review on pelagic fish of inland waters in the Region, including their current exploitation and potential.

The Working Party therefore recommended that India collates such information in collaboration with other member countries, especially Thailand and the Philippines, and the results are prepared in a written form for further discussion at the next Working Party on Inland Fisheries. The attention of research institutions in the Region should be drawn to the need for studies of biology and ecology of pelagic fish in the Region as a step towards assessing their role in inland fisheries development, their economic potential, and the possibility of transfer of suitable species to other reservoirs.

(iv) Evaluation of stocking success with Macrobrachium: The stocking of Macrobrachium in Ubolratana Reservoir and in some other smaller reservoirs in Thailand has been found to considerably increase the total reservoir production of economic species as indicated by high recovery rates, with those for Macrobrachium being higher than those for common carps. Macrobrachium has likewise been grown successfully in the seasonal tanks of Sri Lanka in polyculture with carps. The Working Party has requested Thailand and Sri Lanka to communicate such information to the Secretariat which will collate it and disseminate to member countries.

(c) River and floodplain fisheries

(i) Stocking floodplains: The impact of river flow manipulation in the form of dams and regulated discharge on floodplains of the downstream reaches frequently results in depletion of fish. The question of restocking floodplains was discussed at some length

and it was concluded that information on successful restocking is scarce, and largely in a state of planning. Thailand plans restocking floodplains in the north of the country, Bangladesh will initiate in 1987 stocking of depleted floodplains by various fish species using silver carp as biological indicator of success. Proposals have been put forward in Australia to stock Lates calcarifer into estuaries of rivers dammed upstream. In Sri Lanka, less priority has been given for stocking floodplains due to lack of fingerlings. Only Indonesia has shown success in stocking the River Musi in Southern Sumatra, where Colisa (Trichogaster) pectoralis is now firmly established after being stocked. India has plans for frog hatcheries and release of young frogs into open waters of floodplains often derelict. The currently available meagre experience shows that stocking floodplains is still a vague activity, where benefits cannot be clearly identified, which results in governments placing a low priority to such activities. Nevertheless, Working Party members should monitor during the intersessional period any activities in this field, and towards the end of 1987 the Secretriat should gather all newly available information, e.g. on projects in Bangladesh (silver carp), India (frogs), Australia (Lates calcarifer) and any other in the region, and review such activities for the next session of the Working Party on Inland Fisheries.

(ii) Hilsa fishery: In the past, Hilsa ilisha, (Indian shad), an anadromous fish species, constituted a major part of the catch from the Gangetic river system in the eastern part of the Indian continent as well as in the Narmada and Indus rivers systems of the western Indian subcontinent. Construction of major dams (Farakka barrage) on river Ganga in India and Gulam Mohammad Dam on Indus in Pakistan have obstructed the natural breeding migration of the species upstream of the respective rivers and thus these hydraulic structures have virtually eliminated the Hilsa fishery in the upper river stretches in Bangladesh, India and Pakistan. Biologically, the ascent of the anadromous Hilsa upstream in rivers is essential for the fish to ensure extensive breeding grounds and recruitment of the population returning to the sea for growth.

Revival of Hilsa fishery in the riverine systems of Bangladesh, India and Pakistan is a problem, either to be treated through an international agency or to be resolved through bilateral collaboration between Bangladesh and India for Gangetic Hilsa and between Pakistan and India for Hilsa fishery in Indus river system separately. While under the Bay of Bengal Project (FAO/SIDA) assessment of Hilsa fishery in the marine regime has been initiated in relation to the Bangladesh territory, it is suggested that Pakistan may initiate the proposal to FAO for exploring the possibility to engage a consultant to assess the problem of Hilsa fishery in their territory. After the assessment of the present status of Hilsa fishery in Pakistan in comparison to that before the construction of the Gulam Mohammad Dam on Indus River, FAO may attempt to take up negotiations with India for a possible collaborative project either through a donor agency or through bilaterial arrangements.

(iii) Improvement of basic biological-ecological knowledge of high altitude waterbodies in relation to their fishery potential development: Only a few studies are available on the bio-ecology of the IPFC high altitude waterbodies in relation to their fishery potential development. Countries such as Afghanistan, Pakistan, India, Nepal, Bhutan and China, situated partly or totally within the Himalayas, have been concerned about the paucity of information on aquatic resources in mountainous regions, their faunistic status, fishery potential and possibilities of their development.

For generation of basic information, it is considered necessary to initiate a programme with the following major components: (a) to study environmental characteristics of the cold water streams, lakes and reservoirs in the mountains; (b) to elaborate taxonomic knowledge of the fauna, particularly fish; and (c) to understand the biology and life history of at least some of the important fish species. Such studies would significantly contribute to the development of cold water fishery for food and game. Mahaseer species such as Tor tor, Tor putitora, Tor hexagonolepis, are known to constitute a sizeable part of the daily catches from rivers, streams and lakes, by the hill region people. Schizothorax spp. also occur in good number in catches from the lower regions of the Himalayan waters. While India reported its successful efforts in stocking mahaseer in reservoirs and lakes of Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh and hills of Northeastern region, particularly Arunachan Pradesh, Nepal has initiated stocking of mahaseer in lakes and reservoirs. Considerable research support was made available in India to successfully breed mahaseer and rear fingerlings for distribution in the country. Similarly the development of trout fishery has taken a new line in India with establishment of trout hatcheries under EEC-funded project in Jammu and Kashmir. Pakistan reported about the growing trout fishery in the northern provinces with adequate infrastructure support. Bhutan was cited as an example of successful trout fishery established in its waters with minimum of efforts.

There is a definite demand from various countries occupying the Himalayan terrain to share the knowledge and enlarge the information for bringing about uniformity in the efforts for development of high altitude waterbodies. It was suggested that IPFC, through RAPA, may organize dissemination of technology of breeding mahaseer through an appropriate hand-out and videocasettes, etc., and coordinate the eco-biological studies on high altitude waterbodies. FAO could look into the possibility of organizing training programmes on the identification of stream fish fauna, breeding of trout, mahaseer and Schizothorax, etc.

(iv) Conservation of fish genetic resources: This pertains to the preservation of indigenous wild stock of fish well adapted to the environment through time and space and especially those selected for controlled cultivation. However, man's interference with the environment, indiscriminate exploitation and mismanagement in aquaculture practices, have led to qualitative and quantitative degradation in fish stocks in many countries of the Region. Indiscriminate transfer or transplantation of exotic species have brought about undesirable modifications in fish populations. In aquaculture, reduction in breeding population size has created visible genetic fatigue leading to inferior fish stocks.

While selection, hybridization and genetic engineering have been recognized as crucial to the improvement and development of aquaculture, the Working Party preferred to limit its deliberations to measures of conserving the fish stock in the respective IPFC countries and emphasized an approach to draw the best out of the existing germ plasm through efficient management practices for production.

A review paper prepared by the Secretariat (Annex H) shows an increasing number of activities, both outside and in the IPFC Region, signifying the growing importance of this topic. Deterioration of fish genetic resources, as a result of environment degradation and overfishing, has been noticed, for example, in the River Ganga in India, and in the Pearl River in China.

The IPFC Working Party requested its members to draw the attention of interested groups in their respective countries to Recommendation 7.1 of the FAO Fisheries Technical Paper T217 (published 1981) on the conservation of genetic resources of fish for further discussion. It was recommended that members of the Working Party monitor major activities in their countries and give active support by providing information on the fisheries needs and assist in establishing liaison between the concerned parties.

IPFC member countries should discuss the need for a Code of Practice to reduce the occurrence of adverse effects arising from the transfer or transplant of aquatic organisms. Such Code of Practice (see Annex I) has been adopted by EIFAC and ICES for Europe and North America, and is now also considered by other regional bodies, such as CIFA and COPESCAL. Considerations of individual countries in the IPFC Region should be monitored by the members of the Working Party as well as the IPFC Secretariat.

Recent steps taken by India in establishing the Bureau of Genetic Resources (ICAR) and by Indonesia through its National Committee for Conservation of Germplasm were reported. Also, reference was made to the Symposium in India during April 1986 on conservation and management of fish genetic resources. The IPFC Working Party proposed a joint workshop on the subject during the next combined session of the working parties on inland fisheries and aquaculture which would facilitate identifying needs of the Region.

(v) Structures assisting fish migration

The IPFC Working Party acknowledged the activity of the Secretariat in providing details on structures assisting fish migration. Due to the world-wide interest in this field, two consultancies are being completed on this topic outside the IPFC Region, i.e. Latin America (Argentina), and in the Soviet Union, where such structures have successfully assisted in the migration of non-salmonid fish. It has been pointed out that lack of studies, especially in fish behaviour, hinders a fruitful dialogue with engineers on identifying the best technical design for migrating fish. It is also realised that in the existing large dams without such structures, additional construction would be financially prohibitive. In connection with the only major economically important migratory fish, Hilsa, in the region, such structures are needed only for Pakistan rivers in case of their

further damming.Elsewhere in the region,i.e.India and Bangladesh, there is little hope in rectifying the situation.

It is therefore recommended that Pakistan (i) provides a detailed account of its experience on migration of individual fish species through the fish ladder of the Chashma Barrage; (ii) investigates the possibility of close collabortion between fisheries experts with dam/barrage/irrigation engineers for improving such construction assisting fish migrations or designing new systems for transporting fish over dams and barrages; and (iii) that this information be communicated to the Secretariat for further evaluation and dissemination in collusion with two other studies currently under preparation. The Secretariat is also requested to approach Australia for their experience in this field.

(d) Biology

(i) List of suitable fish species for stocking IPFC lakes and reservoirs: Information collected so far includes 31 species both indigenous and exotic, for which details have been provided on taxonomy, biology and ecology, distribution, and fisheries (see Annex D). Further additions are expected, and the material received by the Secretariat will be assembled and evaluated. There is a need for better information on endemic species of cold mountain waters, and special attention should be paid in the future to surveys and studies of fish which could be used for stocking such waters.

(ii) Ulcerative fish disease outbreaks: Over the last decade, serious ulcerative fish disease outbreaks have occurred in most of the countries of the Region. A regional FAO project, initiated in 1985, conducted an assessment of the situation in eight seriously affected countries by a team composed of experts of the Aquaculture Institute (Thailand). The findings which have been compiled in a report to be released soon, indicated that while in Australia and Papua New Guinea the primary cause is a fungal infection and secondary agents are Aeromonas and Vibrio, in the rest of the Region the primary causative agent is Rhabdovirus, with Aeromonas as a secondary invader. Environmental factors not yet identified seem to trigger the periodic outbreak of the disease, while pollution appears not be the suspect; further spread of the disease can be expected since at present there are no ways and means to contain it. Lately, a very similar fish disease was identified in the Philippines. An international expert consultation on the findings of the regional fish disease is planned for the near future, where the disease and the measures to be taken are to be discussed in depth. urrently, the lack of virological and immunological research capabilities in the Region is a major obstacle to strengthening fish disease diagnosis and control and to the development of preventive and curative measures. The Working Party gave full support to any initiatives on a national and regional level to develop and strengthen fish disease research and monitoring capabilities in the Region, both with internal and external assistance.

(e) Pollution and environment

(i) Use of organic waste in aquaculture and open waters: Utilization of organic waste as manure or supplementary feed for fish in

aquaculture could bring about considerable reduction in operational costs. Traditional as well as semi-intensive aquaculture practised in India utilising raw or treated domestic sewage were the examples discussed in the meeting. About 1 200 ha of open waters in West Bengal, near Calcutta, are under domestic sewage-fed fisheries. ICAR has developed management practices for aquaculture utilising treated domestic sewage for carp culture with a production potential of about 5 tons/ha/yr. Biogas slurry has been found to be acceptable directly as feed for Clarias and Heteropneustes in ponds of India. In some other countries carps have also responded to biogas slurry as direct feed. Advancements in China in regard to integrating aquaculture with crop and animal agriculture could be adapted by IPFC countries through appropriate location-specific modifications. Considerable interest was envisaged by the members of the Working Party on the subject and it was proposed that the Indian Council of Agricultural Research be requested to nominate a suitable scientist to undertake a review study.

(ii) Derelict waters: Most of the member countries of the IPFC Region are facing the problems of vast number of waterbodies having turned into derelict swamps due to heavy infestation of weed, siltation and overall neglect by man. These waterbodies could be reclaimed and rehabilitated for aquaculture. India has proposed two projects for reclamation through engineering modifications of large bheels, ox-bow lakes, dead river courses in Assam and Bihar for support under the World Food Programme. The Philippines has also initiated similar reclamation programmes. Members were requested to promote such programmes in their respective countries.

(iii) Aquatic weed problems, fish and fisheries: It is expected that the consultancy on the review of this aspect currently nearing its completion, will highlight the interactions especially between floating aquatic weeds and fish. There is also the need for successful case studies on management of floating aquatic plants to enhance fish production. Realising that the best success in this respect has been achieved in China, the Working Party suggested that China prepare such reviews which could be considered for publication and dissemination by FAO.

(iv) Statistics and data: The Working Party stressed the need for the timely completion of a study of simple models for predicting fish yields from ponds, reservoirs and lakes of the Region, to determine their validity, and produce a short manual on such models for use in the Region. This study is currently underway in India, and is expected to be completed within the next intersessional period.

(v) Training: The Working Party recommended that:

(i) a list be compiled of established training opportunities in the Region, indicating available courses in various aspects of fisheries training of technical and management character.

(ii) NACA be provided with funding and technical support on its planned production of video-casettes and publications of aquaculture technologies, methods and techniques, especially on fish seed production.

(vi) Other activities: The Secretariat has requested further close collaboration of Members of the Working Party in the search for additions to the provisional List of Inland Fisheries and Aquaculture Specialists in the Indo-Pacific Region, published in 1986 as FAO Fisheries Circular No.796. This publication will be circulated by RAPA to all the IPFC member countries. Any additional information should be sent to the Secretariat in Rome.

AQUACULTURE CONSIDERATIONS (26-27 JUNE 1986)

Due to the cancellation of the IPFC Working Party of Experts on Aquaculture, which was to be held subsequent to the Working Party on Inland Fisheries, the Working Party on Inland Fisheries was requested to review major aquaculture activities for the last biennium, i.e. since January 1984. This was done by presentations of country status reports (see Supplement 1 to this Report) and in a summary of major achievements and constraints by Mr. I. Csavas, Regional Aquaculture Officer. Dr. Chen Foo-Yan, Coordinator of NACA, reviewed NACA activities for the same period. This was followed by discussions on the major areas of concern.

(a) Country reviews

Country reviews on the current aquaculture status in nine IPFC member countries, i.e. Bangladesh, India, Indonesia, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka, Thailand as well as China were presented. They have shown that aquaculture has acquired an acknowledged status in the member countries of the IPFC Region and in China, and has found place in the rural development programmes for these countries. The resources have been identified as well as characterized for their fruitful utilization. Compatible fish species have been adapted for controlled aquaculture, with more and more new species being added to the list of cultivable fishes.The IPFC countries and China have planned for and executed aquaculture development schemes adapted to utilization of different aquatic ecosystems, and with judiciously selected fish species. For example, in China there has been an overall increase in inland fish culture production from 901 000 t in 1980 to 2 379 000 t in 1985. A fast growth rate has been reported also for Bangladesh, India, Indonesia, Malaysia, Nepal, Philippines, Sri Lanka and Thailand. This rising production is not only due to the extended area of operation, but also due to the actual rise in the productivity per unit water area as a result of the adoption of scientific aquaculture.

Most of the IPFC countries and China have taken steps to introduce high technology in the seed production sector in support of aquaculture development. Substantial progress has been noted as a result of adoption of shrimp seed production technology, with increasingly larger areas of brackishwater farms in Indonesia, Philippines, Malaysia, Thailand and India, now using hatchery-produced post-larvae.

It was noted that the governments of the IPFC member countries and China have been giving continuing support to aquaculture development through strengthening and reorganizing technical and extension assistance, mobilization of credit with soft loans, creation of cadres of trained manpower and enactment of suitable rules and regulations. However, aquaculture development in these countries is still imbalanced both within a country, in terms of resource, utilization technology transfer and manpower development, as well as within the region in terms of availability of appropriate technologies and investment. Certain positive trends emerged in aquaculture development, such as government policies in promoting aquaculture in order to raise the quality of life of the segments of the

population. In most of the countries commercial credit is now being extended to support aquaculture. This indicates that aquaculture has been recognized as technically sound and economically viable.

Most of the IPFC countries and China reported adequate emphasis on research and development in both freshwater and coastal aquaculture. The countries concerned have been able to attract sufficient technical and financial support from a number of international donor agencies and in the process have also been able to acquire bilateral coordination for mutual benefits. The assistance of NACA, ICLARM and SEAFDEC in aquaculture development in the IPFC countries, and China, in the fields of research, training extension and technical advice, has been noted with appreciation.

A number of specific needs for enhancement of aquaculture in IPFC member countries and China were mentioned. Among them were the need for: typological approach to classification of aquatic resources for development; availability of appropriate technology; compatible fish species; problems associated with transfers of fish species. Also discussed were the availability of intermediate input such as fish-shrimp seed, mobilization of inputs from the funding agencies, raising of trained manpower, provision of credits and loans, reorganization and strengthening of extension services, mobilization of research support for development of appropriate technologies, etc. These needs in aquaculture development in various countries call for the IPFC to continue its efforts in enhancing aquaculture by, among others, bringing about uniformity in aquaculture technologies in member countries through rapid dissemination of information, arrangements for training with the help of agencies concerned in the region, and improved coordination of aquaculture activities among the member countries.

For more details see Country Status Reports, Supplement 1, to this report.

(b) Summary of major achievements and constraints in aquaculture during the biennium

(i) Fish diseases: As reported before, a sub-regional fish disease survey succeeded in clarifying the background and the primary causative agent of several recent ulcerative fish disease outbreaks in Southeast Asia. Based on the findings of the survey and the recommendations of the forthcoming regional expert consultation, a regional fish health management project proposal will be formulated, which is already included in the shortlist of project ideas submitted to the Fourth UNDP inter-country programme (1987-1991). The project is expected to have components on institution building, research, training and extension and to cover all countries of the region with marked interest in aquaculture. Cooperation and division of work will be sought with other donor agencies supporting fish health management in the region (IDRC, USAID, ODA, etc.).

(ii) Integrated aquaculture: RAPA is planning to publish guidelines for planners on economically viable, verified integrated aquaculture techniques in early 1987 and also to disseminate results of case studies on integrated farming methods tested in brackishwater areas. Progress in the introduction and spread of integrated aquaculture methods was slow but steady and concentrated in those countries where Chinese and Indian major carps are readily accepted by the public.

In those countries where aquaculture serves primarily income generation by developing monoculture of high valued species, spread of integrated farming methods was slow. While the further development of commercial aquaculture methods might lie with the private sector, governments need to continue promoting mass production of cheap foodfishes using efficient integrated aquaculture methods.

Rice-cum-fish production has been revived in many countries, with fish being increasingly produced as a second crop and/or alternative crop to rice. As the most populous countries in Asia have become selfsufficient in rice production and the world market of rice is saturated, the utilization of rice fields for aquaculture purposes is becoming a viable option.

(iii) Coastal aquaculture: RAPA has completed and will publish soon a state-of-the-art report on the utilization of acid sulphate soils for aquaculture. Similar reports on mollusc culture, seaweed culture, giant clam culture, and small-scale crustacean hatchery techniques were also commissioned by RAPA and are planned to be published in 1987. An important breakthrough in crustacean hatchery techniques was achieved recently in Thailand where "backyard hatcheries" of smallholders set up to produce giant freshwater prawn postlarvae on a large scale diversified their production by adapting techniques of penaeid shrimp seed production. These farmers can now shift from Macrobrachium to P. monodon to P. merguensis (and vice-versa) according to the market demands. This technology is ready now for region-wide transfer and should be promoted as it offers a viable substitute to giant commercial hatcheries.

Having satisfactorily solved the problem of hatchery-reared shrimp seed supply, and with the shifting from tidal-fed to pump-fed ponds, a more rapid intensification of shrimp aquaculture has become possible. This shift would result in removing one pressure on mangrove areas, which were misused in many countries by enterpreneurs establishing in them shrimp production ventures. While the establishment of low production tidal-fed ponds, aggravated in many cases by acid-sulphate problem, led to formation of large derelict areas in previously rich mangrove ecosystems, the much higher productivity of pump-fed ponds built outside mangroves offers better utilization of both capital and manpower resources.

(iv) Engineering: Although the engineering principles of designing pump-fed shrimp ponds and drainable fishponds with separate irrigation and drainage canal network are well known, they are still not widely applied. Engineers need correct guidance from aquaculturists on biological needs and requirements of the cultured species. On the other hand, aquaculturists should learn basic engineering principles in site selection, water supply and construction techniques. It was stressed that there is a need for regional engineering training course, similar to that organized in 1983 in Hungary by ADCP, the proceedings of which were published by FAO in a comprehensive document (ADCP/REP/84/21). The text of such course could be used for echo-training organized locally for engineers involved in designing aquaculture facilities. Until now, financial constraints have prevented organization of a similar inter-regional engineering course for coastal aquaculture in the region.

(v) Socio-economics: The importance of socio-economic studies for further development of aquaculture is increasing. Aquaculture production has reached marketing limits in several countries, at least in the case of certain commodities such as carps in Israel and Hungary, milkfish in Taiwan, Clarias and Pangasius catfish, mussels in Thailand. It is more and more evident that technology-oriented development may have to be replaced by market-oriented development based on sound socio-economic studies. Asian countries face severe competition in the world market in almost all agricultural commodities such as foodgrains, dairy products, sugar, palm-oil, cassava. Marketing of aquaculture products (primarily shrimp) is not yet endangered by international competition, but the major markets could become soon saturated if the present rush towards increased production continues. More and more substantial market studies are needed in order to avoid collapse of shrimp prices.

Some countries, such as Indonesia, Philippines and Thailand are facing growing social tensions between entrepreneurs entering the coastal aquaculture business and the dislocated artisanal fishermen. This situation is aggravated by the fact that in almost all countries of the region the entrepreneurs benefit from credit schemes more than the small farmers/fishermen. Access to credit for the poor is very difficult if not impossible despite governments efforts to find a satisfactory solution to this problem. This seems to be one of the biggest constraints for aquaculture development at present.

(c) Review of NACA activities and future programme

During the intersessional period, the NACA project has continued to implement its activities in research, training and information. Research findings have been published in working papers, of which 13 have been distributed to participating governments. A total of 236 aquaculturists and technicians from 26 countries were trained in two regular courses organized annually by the project. In response to the recommendation of the 1984 IPFC Working Party on Aquaculture, NACA conducted two short-term training courses on seed production of penaeid shrimps (1985) and freshwater prawns (1986). Other short-term courses to be organized in 1986 and 1987 include carp seed production, marine finfish seed production and net-cage culture, composite carp culture in seasonal tanks and fish production in lakes.

The project has also established linkages between the four regional lead centres (which form the initial nucleus of the Asian Network) and national centres located in Indonesia, Nepal and the Philippines. Other major achievements during the intersessional period include:

(i) technology transfer through exchange of national experts under the project's TCDC mechanism;

(ii) dissemination of published research findings, training manuals, newsletter, video-tapes on aquaculture technologies, and other aquaculture data and information;

(iii) initiation of the programme for secondment of junior scientists to work as members of research teams of lead centres for in-service training in research methodology for aquaculture and related areas. Six junior scientists from Indonesia, Philippines and Sri Lanka are presently attached to two regional centres;

(iv) collaboration with other agencies and organizations in achieving common goals.

During the next few years, NACA will endeavour to increase its network activities involving free exchange of regional expertise and information. Emphasis will be placed on the implementation of its three major activities in research, training and information will be continued and expanded subject to the availability of resources. In research, however, more effort will be directed at studies aimed at elevating the level of aquaculture to that of animal husbandry. Research will include studies on fish nutrition and feed technology, fish diseases, reproductive physiology and fish genetics. Technology developed will be tested at national centres and adapted to suit local conditions. Emphasis will also be placed on socio-economic studies of aquaculture production, and operation at the grassroot level to assess more accurately the impact of aquaculture development on the socio-economics of rural community. The project will also supplement the effort of ADCP in strengthening the role of women in aquaculture development. The momentum developed for establishing linkages between national and regional centres will be increased along with the organization of short-term training courses and the strengthening of the programme for secondment of junior scientists. Increased effort will also be directed at dissemination of information through publication of research findings and training manuals, and production of video-tapes on aquaculture technologies. The latter will be directed at four levels of audience: the farmers, the extension workers and trainers, the researchers and the administrators concerned with planning and policy matters.

One of the most important tasks of the project during the next phase is to develop a technical core group of regional experts of different nationalities to provide assistance to countries in the region in aquaculture development planning and programming, feasibility studies, formulation of projects and on technical issues. This core group which will be funded by the participating governments of the network will eventually replace most of the project professional staff when UNDP financing of the core programme diminishes by the end of the next programme cycle (1987-1991).

(d) Discussion

Areas of concern covered in discussion were: seed production; feed development and production; disease control; genetic improvement; and engineering. Marketing outlook and the need for an international journal for rapid information on aquaculture were also discussed.

(i) Seed production: Sri Lanka has mentioned having a problem with the provision of a large quantity of seed for stocking programmes due to lack of sufficient pond space in their fish breeding centres. Need for advice on mahaseer induced breeding has been mentioned by Pakistan. Bangladesh is interested in obtaining assistance in achieving self-sufficiency in hormone production for induced breeding of carps. NACA offered to coordinate the provision of such assistance using TCDC mechanism. Assistance in marine fish seed production has also been offered.

(ii) Feed development and production: Problems of sufficient supply of good quality and economically accessible feed have been highlighted. Feed pellets imported by some countries, for example Indonesia, have been found to have short shelf life, resulting in rancidity after some storage time in hot and humid climates. Solution to this problem is possible by mixing feed from pre-mix components and locally available ingredients at farm sites.

Thailand expressed the need for assistance in the production of microencapsulated feed for critical stages of some species for which mass production of livefood such as rotifers or Moina is uneconomical. Feed development is considered very important in countries where intensification is the aim of aquaculture. A model study mapping the available potential local feed components has been produced under a TCP project for Papua New Guinea, and will be circulated among the IPFC member countries and China. It was agreed that continuous effort in improving feed development and production is an important factor for successful aquaculture and FAO should keep it on its list of priorities.

(iii) Disease control is an ongoing concern in the countries of the IPFC Region, and shortage of fish disease specialists is common. The need for national fish disease diagnostic centres which could provide quick service to aquaculturists was emphasised. Another area of concern discussed was the possibility of introduction of fish diseases by uncontrolled trading in seed and ornamental fish among the IPFC and other countries. Most countries of the IPFC Region have no quarantine requirements for imported fish. It was pointed out that the establishment of an effective quarantine system is costly, requires a high number of well trained manpower, and must be rigidly enforced - conditions which cannot yet be met in the region. Notwithstanding this, the Working Party has agreed that wherever possible, quarantine conditions should be established, especially where larger transfer of seed can be controlled by government and other specialized agencies. It is hoped that the fish disease situation in the IPFC countries will improve with the proposed regional UNDP fish health management project. This project also has a substantial training component, where each country will have an opportunity for obtaining training for 1-2 specialists.

The Code of Practice to reduce the risk of adverse effects arising from the introduction or transfer of inland aquatic organisms, as available for Europe, may assist in formulation of further ideas for protection of indigenous fish stocks against import of diseases (see Annex I).

(iv) Genetic resources of fish: More attention should be paid in future to the genetic resources of fish. In Indonesia, the genetic quality of fish seed has been declining, probably as a result of inbreeding and negative selection, indicating the need for enlarging gene pools by import of new strains. The Working Party has requested FAO for advisory assistance in this field.

(v) Other items: Marketing outlook concern was expressed that is based on the increase in shrimp and other high-value fish production through high technology-oriented aquaculture in Latin America and elsewhere outside Asia. It was felt that this could, in the future, limit export markets, especially in the U.S.A. and Japan, for the IPFC countries production. It was therefore suggested that the Fishery Industries Division of FAO considers preparation of a global study on foreign exchange earning fish and seafood commodities with regard to their supply and demand in the future, particularly for the benefit of IPFC countries.

(e) Publications

The members of the Working Party emphasized the continuing need for international journal for rapid dissemination of aquaculture information. The FAO Aquaculture Bulletin filled this role in the past, and the members have given full support to its revival.

WORKSHOP ON STRATEGIES FOR THE MANAGEMENT OF FISHERIES AND AQUACULTURE IN MANGROVE ECOSYSTEMS

1. BACKGROUND

Mangroves occupy about 171 000 km^2 worldwide. Associated with the mangroves are some 83 000 km^2 of lagoons and estuaries. The small-scale fisheries in mangrove-associated lagoons and estuaries yield, in round terms, 1 million tons of fishes, shrimps, crabs and molluscs annually and employ about 0.5 million fisherfolk, not including recreational fishermen which, in some countries, far outnumber commercial and subsistence fishermen. The yield does not include that of organisms which utilise the mangrove ecosystem as feeding, breeding and nursery areas, but are caught elsewhere.

Aquaculture in mangrove ecosystems occurs mainly in the IPFC region. The prevalent kind of aquaculture in mangroves is the culture of milkfish and penaeid shrimps in ponds. Worldwide there are about 0.6 million ha of shrimps and milkfish ponds of which 0.5 million are in Asia, but not all of the ponds are in mangrove areas.

The economic value of this aquaculture is very high because the demand for penaeid shrimps ensures high prices. Six hundred thousand aquafarmers are engaged in the pond aquaculture of shrimp and milkfish worldwide.

Recognizing the importance of the mangrove ecosystem for fisheries and aquaculture, the Inland Fisheries and Aquaculture Working Parties of IPFC at their second session (1984) recommended that mangrove management forms the topic of the next session. Accordingly, the Secretariat organized the present workshop with the objective to formulate strategies for the management of fisheries and aquaculture in mangrove ecosystems.

2. THE WORKSHOP

The Workshop was held at the FAO Regional Office in Bangkok from 23-25 June 1986. The Workshop was conducted in 3 parts: presentation of introductory and experience papers of which there were 13, general discussions and formulation of management strategies, and review of the workhop report and recommendations.

A list of participants is in Annex C, and list of presentations and authors are in Annex J.

The discussion session of the Workshop focused on the formulation of management strategies for fisheries and aquaculture in mangrove ecosystems. A summary of the discussions and the nine management strategies formulated by the Workshop are presented in the following paragraphs.

3. PERCEPTIONS OF MANGROVE ECOSYSTEMS FROM THE POINT OF VIEW OF FISHERIES AND AQUACULTURE

The formulation of management strategies depends on how the mangrove ecosystem and its associated fisheries and aquaculture are perceived. The Workshop listed the following perceptions which shaped its management strategies:

- For the purposes of fisheries and aquaculture, management should include not only the mangroves themselves, but also the associated lagoons, estuaries and their living systems.

- Mangrove-associated fisheries are valuable.

- The mangrove ecosystem provides a number of benefits both for fisheries and aquaculture (e.g. shelter, seed, materials for gears and houses, feeding, breeding and nursery areas for fished resources, sites for aquaculture).

- There are acceptable uses of the mangrove ecosystem other than for fisheries and aquaculture. There will be increasing pressure to accommodate these uses, but management at national and local levels can provide for sustainable yields from multiple users.

- In the eyes of many users of the mangrove ecosystem pond aquaculture in mangroves is seen as a destructive use.

- Mangroves are traditionally used for pond aquaculture. Although presently available technology can provide alternative sites for use in other areas, this is not yet possible in all countries for economic and social reasons.

4. THE OBJECTIVE OF MANGROVE ECOSYSTEM MANAGEMENT FROM THE POINT OF VIEW OF FISHERIES AND AQUACULTURE

The principal objective of management identified by the Workshop is to increase, or at least maintain, the fishery and aquaculture benefits associated with the mangrove ecosystem.

5. MANGROVE ECOSYSTEM MANAGEMENT PROBLEMS AND MANAGEMENT STRATEGIES

From a broad point of view the most serious mangrove ecosystem management problems are that there is no clear definition of uses, or where there is definition of uses by various sectors, they are often conflicting. The nine management strategies set out in the following paragraphes were formulated to address these problems.

(a) Management Strategy 1: Improve comprehensive planning

Lack of comprehensive planning such as river basin planning and coastal zone planning, can be blamed in large part on the paucity of economic and resource informatin required to rationally manage the mangrove ecosystem. The management solution proposed by the Workshop is the quantification of mangrove resources including the identification of user groups, their economic importance, and their environmental impacts. As a first step, countries should inventory the mangrove resource data already available. If essential informatin is found lacking, then international or bilateral technical assistance agencies can be requested to help to acquire it using techniques such as remote sensing, if national capabilities are not sufficient.

(b) Management Strategy 2: Improve communications at international and national levels

Poor communication was identified as a management problem at two levels. At the international level, poor communications can lead to duplication of effort aimed at mangrove ecosystem management. On the positive side, communications and cooperation on mangrove management already have been developed between FAO and UNESCO in the Indo-Pacific region. The Workshop recommends that these existing links should be further strengthened by the FAO Secretariat at Headquarters and at the

Regional Office, and whenever possible, extended to other international organizations (e.g. UNEP), and to bilateral technical assistance agencies active in coastal zone management (e.g. GTZ, USAID, IDRC).

The Workshop felt that at the national level poor communications were the difficulty in communicating management needs to policy and decision makers. Here the already existing National Mangrove Committee (NATMANCOMS) can play an important role in information transfer and policy formulation. However, it has to be recognized that fishery and aquaculture interests and responsibilities in mangrove ecosystems are sometimes shared among a number of government agencies and educational institutions as well as by the private sector. In order to fully represent these varied interests and responsibilities, it may be useful for NATMANCOMS to balance their membership in order to increase their effectiveness in accommodating the needs of fisheries and aquaculture.

(c) Management Strategy 3: Exchange information on fishery and aquaculture management options and technologies

If management is to be successful, it has also to be flexible. This is necessary because rapidly evolving information and technologies may require rapid changes in management strategies. By quick adoption of new technologies management efficiencies can be realized. Information and technologies useful for mangrove ecosystem management can be acquired by exchange of information among countries of the region. The Workshop recommends that the IPFC Working Parties on Inland Fisheries and Aquaculture assume responsibility for periodic updating of research and development advances in mangrove management for fisheries and aquaculture respectively at its sessions. Each member of the respective working parties should endeavour to acquire this information from his own country. The Secretariat will also contribute information, but will concentrate on management strategies and technologies developed in other regions which could be useful in the IPFC region.

Seagrasses in many ways are functionally similar to mangroves in that they provide substrate, shelter and feeding areas for fishes and other organisms of economic importance and they are often important fishing grounds. Locationally, seagrasses are often found in shallow lagoons and estuaries ringed by mangroves. Thus, seagrasses are sometimes part of the mangrove ecosystem.

The Workshop called attention to the importance of seagrasses to fisheries in particular, and as important components of the mangrove ecosystem in general. In this regard seagrasses require management as part of the whole and in their own right.

As a first step towards exchange of information on seagrasses and their management the Secretariat will compile a bibliography on organisms of economic importance associated with seagrasses and seagrass management. The bibliography will be distributed to the members of the IPFC Inland Fisheries and Aquaculture Working Parties. Also, the Secretariat will discuss the importance of seagrass management with officers of the FAO Marine Resources Service and investigate the possibility of a joint activity to produce a compendium of seagrass associated species of economic importance.

(d) Management Strategy 4: Increase public awareness of the value of fisheries and aquaculture in mangrove ecosystems

The Workshop concluded that although there is a broad public awareness of the value of mangrove ecosystems for recreation and wildlife, there is a

lack of knowledge of the importance of fisheries and aquaculture in mangrove ecosystems. In this regard, it should be mentioned that fao will publish by the end of the year a worldwide compendium of mangrove-associated species of economic importance. So far about 1 800 species have been identified among algae, molluscs, crustaceans and fishes. If the compendium has a good reception, it will be upgraded to an FAO catalogue of mangrove associated species of economic importance.

One way for a timely and comprehensive dissemination of information about fishery and aquaculture management in mangrove ecosystems is to contribute information to Bakawan [1/] (such as a summary of this Workshop). Such contributions would be welcomed by Bakawan because it presently lacks fishery and aquaculture content. Members of the IPFC Working Parties on Inland Fisheries and Aquaculture should consider this avenue for promoting fishery and aquaculture interests in mangrove ecosystems.

(e) Management Strategy 5: Zoning relative to allocation to relieve heavy and uneven patterns of exploitation

A major mangrove management problem identified by the Workshop is that mangrove ecosystems are heavily exploited, and/or impacted. Subsidiary or related problems are that the geographical pattern of exploitation is uneven; some uses are non-sustainable; some uses while sustainable, may not be compatible with fisheries and aquaculture; and pond aquaculture sometimes is viewed as being incompatible with other uses.

In theory, it should be possible to overcome uneven or heavy exploitation of mangrove resources, whether of fish or any other resource, by better geographical allocation. The Workshop feels that zoning could overcome this problem. General mangrove zoning can best be accommodated through national mangrove committees. Zoning for fishery and aquaculture in mangrove ecosystems should be undertaken only with the advice of competent fishery and aquaculture authorities in each country.

(f) Management Strategy 6: Reduce non-sustainable uses, degradation and destruction

One approach to ovecoming non-sustainable uses is to acquire comprehensive knowledge of the economic values of the intact system when rationally exploited for fisheries, aquaculture and other sustainable uses. The sum of the values of all of the sustainable uses should always exceed the value of any nonsustainable use. Economic analyses in general, and particularly cost-benefit analysis, are tools which can be used for this purpose. In this regard, it should be noted that FAO already has under preparation a manual for the cost-benefit analysis of mangrove ecosystem management for fisheries and aquaculture. The manual is designed to be used by fisheries and aquaculture personnel and is meant to enable them do their own analyses of fishery and aquaculture management costs and benefits in their own national mangrove ecosystems.

Another way to limit non-sustainable uses from the point of view of fisheries and aquaculture is to place emphasis on the traditional rights of fishermen to pursue a living.

1/ Bakawan is the newsletter of the Regional Mangrove Information Network of Asia and the Pacific which is published quarterly.

(g) Management Strategy 7: Investigate the compatibility of other sustainable uses of the mangrove ecosystem with fisheries and aquaculture

Although uses such as forestry are sustainable in the mangrove ecosystem, the compatibility of such uses with fisheries and aquaculture has been little studied. The Workshop recommends that a literature review is undertaken by FAO to determine the compatibility of forestry and other sustainable uses with fisheries and aquaculture. The report should contain recommendations for applied research to determine user compatibilities. These recommendations should be submitted to the UNESCO Regional Mangrove Project which, in its second phase, is undertaking applied mangrove research. If financial resources are sufficient, a second review is to be undertaken. This is to be a review of sustainable uses of the mangrove ecosystem on a country by country basis in the Indo-Pacific region.

(h) Management Strategy 8: Restore degraded or destroyed mangrove and seagrasses ecosystems

The mangrove ecosystem provides valuable benefits for fisheries and aquaculture. Therefore, restoration of these benefits becomes a viable management strategy if restoration can be shown to be ecologically possible and economically viable.

As a start towards evaluating restoration as a management strategy, the Workshop recommends that FAO begin to disseminate information on the restoration of mangroves and seagrasses to the countries of the IPFC region. Also, with regard to restoration the Workshop noted that there is presently a pilot seagrass restoration project in the Philippines, and that seagrass transplantation is underway in Australia. Bangladesh, Thailand and the Philippines have acquired experience in mangrove afforestation or restoration. Thus, there may be possibilities for TCDC as a means to aid mangrove or seagrass restoration in the IPFC region.

(i) Management Strategy 9: Apply aquaculture technologies which minimize damages to the mangrove ecosystem

Damage to the mangrove ecosystem caused by pond aquaculture can be minimized by improved planning for aquaculture development and by establishing and diminishing better criteria for site selection. FAO already has underway a Regular Programme activity on planning for aquaculture development using remote sensing and geographic information systems which can contribute to this need. The Workshop recommends that FAO prepares guidelines for the siting of aquaculture in mangroves. A useful by-product of better planning and siting of aquaculture will be a lessened impact of pond aquaculture on mangrove ecosystems.

ANNEX A

AGENDA

19 - 21 June

1. Opening of the Session
2. Election of the Chairman and Rapporteurs
3. Adoption of the Agenda and arrangements for the Session
4. Review of intersessional activities and implementation of recommendations on inland fisheries (Secretariat)
5. Country reviews of intersessional activities (Participants)
6. Special areas of interest for future activities
7. Any other matters
8. Discussion

22 June

9. Excursion for all participants

23-25 June

10. Workshop on strategies for the management of fisheries and aquaculture in mangrove ecosystems

26-27 June

11. Summary of intersessional activities on aquaculture during the last biennium
12. Country reviews on aquaculture activities during the last biennium (Participants)
13. Discussion
14. Adoption of the Report

ANNEX B

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ANNEX C

LIST OF SPECIES SUITABLE FOR INTRODUCTION AND STOCKING OF THE IPFC LAKES, RESERVOIRS AND SMALLER WATERBODIES

From the following countries, filled-in questionnaires have been received:

AUSTRALIA (Mr. M. MacKinnon):	*Bidyanus bidyanus* *Hephaestus fuliginosus* *Lates calcarifer* *Macquaria ambigua* *Oxyeleotris lineolatus* *Scleropages leichardti* *Scleropages jardini* *Strongylura kreffti* *Tandanus tandanus* *Toxotes chatareus*
INDIA (Dr. V.R. Desai):	*Catla catla* *Cirrhinus mrigala* *Labeo calbasu* *Labeo rohita* *Tor tor*
INDONESIA (Dr. Hardjamulia):	*Osteochilus hasselti* *Osphronemus gouramy* *Cyprinus carpio* *Trichogaster pectoralis* *Oreochromis niloticus* *Puntius gonionotus*
NEPAL (Mr. R. Rajbanshi):	*Cyprinus carpio* *Ctenopharyngodon idellus* *Hypophthalmichthys molitrix* *Aristichthys nobilis*
PHILIPPINES (Mrs. E.V. Baluyut):	*Chanos chanos* *Cyprinus carpio* *Oreochromis niloticus* *Oreochromis mossambicus*
SRI LANKA (Dr. J. Samarakoon):	*Etroplus suratensis* *Labeo dussumieri*
THAILAND (Dr. O. Pawaputanon):	*Cirrhinus julieni* *Corica isannensis* *(goniognathus)* *Kryptopterus apogon* *Labeo rohita* *Oreochromis niloticus* *Puntius gonionotus*

ANNEX D

SELECTED TECHNICAL PAPERS, CIRCULARS AND REPORTS WITH RELEVANCE TO THE IPFC REGION INLAND FISHERIES PUBLISHED BY FAO FISHERIES DEPARTMENT

1. Technical Papers

*Alabaster, J.S., 1986 Review of the state of water pollution affecting inland fisheries in Southeast Asia. FAO Fish.Tech.Pap., (260):25 p.

Beveridge, M.C.M., 1984 Cage and pen fish farming. Carrying capacity models and environmental impact. FAO Fish.Tech.Pap., (255):131 p. Issued also in French and Spanish.

*Petr, T. (ed.), 1985 Inland fisheries in multi-purpose river basin planning and development in tropical Asian countries: three case studies. FAO Fish.Tech.Pap., (265):166 p.

Ploskey, G.R., 1985 Impacts of terrestial vegetation and preimpoundment clearing on reservoir ecology and fisheries in the United States and Canada. FAO Fish.Tech.Pap., (258):35 p.

Scudder, T. and T. Conelly, 1985 Management systems for riverine fisheries. FAO Fish.Tech.Pap., (263):85 p. Issued also in French.

Welcomme, R.L., 1985 River fisheries. FAO Fish.Tech.Pap., (262):330 p.

2. Circulars

*Baluyut, E.A., 1986 Planning for inland fisheries under constraints from other uses of land and water resources: general considerations and the Philippines. FAO Fish.Circ., (798):44 p.

*FAO, 1986 Inland fisheries of Indo-Pacific countries. FAO Fish.Circ., (794): 59 p.

*_____, 1986 A provisional list of inland fisheries and aquaculture specialists in the Indo-Pacific region. FAO Fish.Circ., (796): 67 p.

*Sreenivasan, A., 1986 Inland fisheries under constraints from other uses of land and water resources: Indian subcontinent and Sri Lanka. FAO Fish.Circ., (797):68 p.

Vanderpuye, C.J., 1985 Evaluation guidelines for rational planning and management of tropical and subtropical inland fisheries under constraints from other uses of land and water resources: Africa. FAO Fish.Circ., (789):44 p.

3. Reports

*Indo-Pacific Fishery Commission (IPFC), 1984 Report of the second session of the IPFC Working Party on inland fisheries. New Delhi, India, 23-27 January 1984, and Report of the Joint Workshop of the IPFC Working Party on inland fisheries and the IPFC Working Party on aquaculture on the role of stocking and introductions in the improvement of production of lakes and reservoirs. New Delhi, 24-25 January 1985. FAO Fish.Rep., (312):56 p.

* Intersessional publications resulting from the last Working Party recommendations.

ANNEX E

DEVELOPMENT OF CHINA'S RESERVOIR FISHERIES

by

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The development of China's reservoir fisheries commenced only about three decades ago with the mass construction of dams for flood control and irrigation. By 1983, 86 567 reservoirs of various sizes had been constructed throughout the country. Of the reservoirs constructed, medium and small-scale reservoirs constituted the overwhelming majority, with small reservoirs accounting for 96.88% of the total (83 865 reservoirs), medium reservoirs 2.73% (2 367) and large reservoirs 0.39% (335). The total water area for these reservoirs suitable for fish culture is 2.0 million ha, whereas 1.33 million ha have so far been utilized.

The major approach used to increase reservoir fish yield in the development of reservoir fisheries in China is the combination of capture fisheries with aquaculture using the "stock and take" mode of fisheries management, and stocking plankton feeding Chinese carps. An example of this practice is the Qing Shan Reservoir, a reservoir of 800 ha, constructed in 1960. Here, the "stock and take" mode has been implemented for two decades. The continuous stocking of between 800 000 and 1 million fingerlings per year (equivalent to between 1 500 and 1 800 per ha) for the past 22 years, has resulted in an average yield of 547 kg/ha/yr.

In the development of reservoir fisheries in China, the shortage of large-size fingerlings for stocking has been a longstanding problem. Various methods have been developed over the past years to overcome this shortage, such as the construction of ponds with clay cores on sandy river beds below the dam, damming coves for fingerling production, and cage culture.

The development of fingerling cove culture was initiated in the 1960's. There are at present two basic types of cove culture practised in China. One uses the drawdown area in a cove by blocking it off with small mesh nets for raising fingerlings without supplementary feeding. The other is the construction of terraced ponds with earthen embankments in the upper reaches of a cove.

The cage culture of fingerlings with floating net cages was developed in the early 1970's, and this practice is widely used throughout China. It does not require land, results in better utilization of water space, and supplementary feeding and fertilizers are not usually needed. The low cost, high productivity and easy management are the other positive aspects of this method.

As the development of reservoir fisheries in China will continue to rely on artificial stocking, the demand for fingerlings shall be a continuing problem. Other approaches are now being proposed to solve this problem.

Further improvement in fish yield has been achieved by the introduction of more efficient capture methods. These have greatly improved the catchability of both pelagic and demersal fish, both Chinese carps and predators. An example is the intensive fishing method developed by the Xinanjiang Reservoir in the 1960's and carried out once or twice a year which aggregates the fish with block nets, trammel nets, seine nets and large set nets, with the aid of sound and visual effects. This is now commonly practised, on varying scales, in reservoir fisheries throughout China.

The management of reservoir fisheries is now supervised by the Ministry of Water Conservancy and Electric Power (MWCEP). To enhance the development of reservoir fisheries, MWCEP has stipulated that fisheries should be incorporated in the future surveying, designing and construction of new reservoirs, and costs and inputs must include fishery installations and facilities. There are at present three basic forms of management for reservoir fisheries: State managed (for large reservoirs), jointly managed (for medium and small reservoirs), and household or individually managed (for small or mini reservoirs).

A review of the present status of China's reservoir fisheries, with two case studies of reservoir fisheries development using new approaches as discussed above, has been issued as an FAO Fisheries Circular.*

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* Lu, X.(comp.), A review on reservoir fisheries in China. FAO Fish.Circ., 1986 (803):37 p.

ANNEX F

PELAGIC FISH IN UBOLRATANA RESERVOIR

by

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Since 1974, or 7 years after closing of the Ubolratana dam, the dominant part of the fish catch was represented by two pelagic species, i.e. Corica goniognathus and Cirrhinus jullieni. The average catch of these two species has been 770 tons per year. The maximum annual production reached 1 033 t or 51.8% of the total catch in 1981. If food supply for these species remains abundant and the fish maintain their high reproduction rate, their high yield may persist for a number of years. Both species appear to have good potential to provide cheap food and both species would be introduced to other reservoirs with a vacant niche.

The Ubolratana reservoir has a large number of indigenous fish plus those introduced into the reservoir later on. The major group of fish is similar to those in other Thailand reservoirs, and consists mainly of carp, murrel, catfish and miscellaneous species. Of the total only about 40 species are encountered in the catch and none of them are of economic importance: Ophicephalus striatus, Krytopterus apogon, Mystus numerus, Oxyeleotris marmoratus, Molurius crysophekadion, Osteochilus melanopleura, Puntius gonionotus, Cirrhinus jullieni and Corica goniognathus. All species but one have been abundant in the catches since the beginning of the reservoir. C. goniognathus became the major species of the catch only in 1974. Since then, C. goniognathus together with C. jullieni represented between 25.8 to 51.8% by weight of the annual catches from this reservoir, equivalent to a range of 1 389 to 2 575 t (1974-1985). Corica population undergoes more dramatic changes from year to year than Cirrhinus (Table 1).

C. goniognathus and C. jullieni are excellent prey for fish predators such as Ophicephalus striatus, Kryptopterus apogon, Mystus numerus and Oxyeleotris marmoratus. Both C. goniognathus and C. jullieni are small-size species that feed mainly on phytoplankton and aquatic insect larvae. It takes about 2 months or less for C. goniognatus to be adult at the total length of 5 to 7 cm, while C. jullieni needs to reach 10-12 cm for its sexual maturity. Both species spawn several times a year, which makes all sizes of fish readily available all year round for predators, especially for O. marmoratus which is also a multispawn predator.

An analysis of stomach content of several predators revealed that adult C. goniognathus and C. jullieni are their preferable prey species, but it seems that the number of predators is not high enough to make any sizeable impact on the abundant prey. Several other species such as Puntius rasbora and some others are also preyed upon.

Considerable amount of C. jullieni and C. goniognathus can be captured by commonly used fishing gears such as sieve net, giant lift net and cast net. Giant lift net is operated in conjunction with gill net to catch C. jullieni when they migrate in school for feeding activity. C. goniognathus is fished early in the morning by using sieve net with light attraction. This technique also captures some young economically valuable fish that are sensitive to light. However, 95% of the catch consists of C. goniognathus.

Table 1

Annual yield and percentage (by weight) of 3 types of fish in Ubolratana reservoir (1960-1985)

Years	Total yield (tons)	Total predators (tons)	Corica (tons)	Cirrhinus (tons)
1969	1 950	378.5 (23.8)	-	n.d.
1970	1 385	455.6 (32.9)	-	71.4 (5.1)
1971	1 988	475.3 (23.9)	-	403.6 (20.3)
1972	1 623	494.0 (30.4)	-	323.7 (19.9)
1973	1 581	345.1 (21.8)	-	187.2 (11.8)
1974	2 575	526.1 (20.4)	149.5 (5.8)	514.3 (20.0)
1975	1 644	185.5 (11.3)	309.5 (18.9)	278.8 (16.9)
1976	2 267	213.8 (9.4)	319.2 (14.0)	557.3 (24.6)
1977	2 270	197.6 (8.7)	310.3 (13.7)	570.2 (25.1)
1978	2 120	311.1 (14.7)	298.8 (14.1)	597.6 (28.2)
1979	1 493	319.8 (21.4)	21.5 (1.4)	464.5 (31.1)
1980	1 214	226.1 (18.6)	155.1 (12.8)	417.3 (34.4)
1981	1 996	306.5 (15.4)	311.0 (15.6)	722.2 (36.2)
1982	1 389	216.9 (15.6)	281.7 (20.3)	509.5 (36.7)
1983	2 169	196.4 (9.1)	344.6 (15.9)	668.3 (30.8)
1984	1 892	122.0 (6.5)	222 (11.7)	769.6 (40.7)
1985	1 186	58.7 (4.9)	149 (12.5)	320 (26.9)

The figure in parentheses gives percentage of the total yield by weight. The total yield does not include 470 tons consumed by fishermen/year
n.d.: no data

C. goniognathus and C. jullieni can be prepared in various forms of product, but they are unsuitable for fish sauce production because they secrete mucus and contain too much fat. Good quality fish (large and fresh) can be dried and supplied directly to the market. Salt is used to preserve low quality fish before transferring them to fermenting fish factories.

ANNEX G

CONSERVATION OF GENETIC RESOURCES OF FISH
(Background information prepared by the Secretariat)

In 1971, FAO established an ad hoc Working Party on Genetic Resources of Fish, which reviewed progress in genetic selection for fish farming, identified priority areas for research, and made several recommendations for the conservation of fish genetic resources. Included were suggestions that methods for doing so needed urgent study, that a catalogue of threatened genetic resources of potential use to aquaculture should be prepared, and that the collection of wild species of potential usefulness should be undertaken. These actions have not taken place, largely because there has been no consensus on the criteria that are needed to limit such work to manageable proportions. The FAO Technical Conference on Aquaculture, held in Kyoto, Japan, 26 May to 2 June 1976, reaffirmed the need to maintain the genetic diversity in artificially propagated stocks, noted that indiscriminate transfer of fish and shellfish have had, in some cases, adverse effects on indigenous stocks. It called for increased research on fish genetics as there was a substantial lack of information on this subject, making the formulation of selective breeding programmes difficult.

During disucssions held in FAO, Rome, June 1979, it was agreed that the variety of needs and problems associated with this aspect of genetic conservation could not be adequately reviewed and assessed by a single individual. It was proposed that a group of experts be convened to accomplish this review and propose a balanced and practical programme of action. The resulting Expert Consultation on the Genetic Resources of Fish was held in Rome, 9-13 June 1980 (see FAO Technical Paper T217). The meeting emphasized the importance of maintaining breeding populations of an effective size of at least 50 for short-term fitness and of at least 500 for long-term survival, and of avoiding "genetic bottlenecks" created by reduction of breeding populations to small size for one or more generations. The report also considered available technologies for the monitoring, preservation and enhancement of genetic resources in closely managed fish stocks. It concluded by presenting recommendations addressed to five different groups: international organizations, government, aquaculturists and fishery managers, conservationists and research scientists.

Since 1980, FAO Regional Bodies - EIFAC, COPESCAL and CIFA - have paid increasing attention to this topic. The deliberate and accidental transfer of species and regular stocking have been scrutinized for their possible impact on genetic resources. For example, a background paper on this topic, prepared for the Sixth Session of CIFA meeting in Lusaka, Zambia, 1 October 1985, has provided a summary of the reasons for transfers and introductions, and listed dangers associated with such. Elsewhere, concern has been expressed by fishery biologists and managers even over the transfer of "native" species such as the translocation of salmonids within North America, and transfer of Australian freshwater fish within Australia, into areas where they do not naturally occur. It has been feared that the major impact of translocations would probably be the destruction of ecotypic forms below the species level due to hybridization, competition, pathogen transfer and direct predation. Because ecotypes comprise the total range of genetic variability available for future use by commercial aquaculture, any reduction in this genetic potential is a loss to these industries in the future. It has therefore been recommended to apply a conservative approach to translocation of "native" fish coupled with specific ecological research on candidate species.

Selection, hybridization and genetic engineering recognized as crucial to the improvement and development of aquaculture and fisheries, led to organizing a symposium on selection, hybridization and genetic engineering in aquaculture of fish and shellfish for consumption and stocking, held in conjunction with the Fourteenth Session of EIFAC, 27 May to 3 June 1986, Bordeaux, France. The symposium put forward a series of recommendations which included the following: that historically well-established natural gene pools be protected as they are the prerequisite to any successful breeding programme; further development of multi-dimensional techniques be encouraged in order to obtain a better understanding of the genetic composition of wild and hatchery populations; available means of sex control be utilized in evaluating candidates for introduction of exotic species for aquaculture or stocking; and, because artificially produced hybrids may destroy existing ecological structures, strict supervision of their production be exercised by governmental or other relevant institutions.

Several recent activities have also taken place in the Indo-Pacific Region. In India, during the past few decades, the aquatic ecosystems have been subjected to various natural and man-induced stresses which have adversely affected the fish populations. Such destruction of habitat integrity has been identified as affecting ecological and genetic thresholds since fish are prone to more rapid evolution in response to environmental alterations than other invertebrates. Identifying the need to conserve the rich and diverse fish genetic resources of the country, the Government of India has established in Allahabad a Bureau of Fish Genetic Resources under the Indian Council of Agricultural Research, New Delhi. As a first step, the Bureau has aimed at collating basic information on the resources to evaluate their diversity and genetic and ecological vulnerability. A publication entitled "The fish genetic resources of India" prepared by Dr. A.G. Jhingran and published by ICAR (1984), introduces the problem, provides baseline data on the major inland and marine fish species of economic importance, gives information on the transplantation of indigenous fish into different drainages in order to improve the local fish fauna, and discusses the transfer and use of exotic fish. Among the major problems are the decline in riverine fish, especially the Ganges, Godavari and Cauvery river fish stocks, such as major carps. In the upper reaches, there has been a drastic decline in Mahseer (Tor spp.). Further stress has been imposed by environmental degradation and modification, such as damming. The rapid growth of aquaculture has led to captive populations becoming prone to the deleterious effects of inbreeding, reduction in genetic variability, resulting in homozygozity of unfavourable genes. The overall result is loss of vigour, viability and fecundity.

The Symposium on Conservation and Management of Fish Genetic Resources of India, 11-13 April 1986, had two major objectives: to determine priorities in research for conservation and management of fish genetic resources, and to establish coordination and cooperation among various scientific agencies involved in research and conservation of the fish genetic resources of the country. On the technical level, the symposium dealt with a number of topics such as cytogenetics, cytotaxonomy, population genetics, biometrical genetics, inbreeding, inheritance, sex reversal, gynogenesis, domestication in situ and cryogenic preservation of the resources.

Elsewhere, widespread mixing of genetic strains of cichlids, especially of the Tilapia group, both for introduction into lakes and for aquaculture, has resulted in a considerable mixing of gene pools. The possibility of isolating suitable strains for special purposes (e.g. high growth rates, salinity tolerance) has been reduced.

In the case of tilapias, it will normally be more cost-effective to use the local wild stock as a source of broodstock for aquaculture than to import a so-called "pure line". This is because such "pure line" stocks are not only unlikely to be "pure", but are also likely to have reduced vigour.

In 1985, the Tilapia Genetics Workshop was held 20-22 June 1985, at the Freshwater Aquaculture Center of Central Luzon State University, The Philippines. The meeting was oriented towards genetic improvement of stocks and concentrated on the Nile and red tilapias. The need for inter-agency cooperation in research planning and exchange of information was stressed.

The IPFC Working Party of Experts on Inland Fisheries may wish to review the present situation in the individual member countries and in the region and to put forward suggestions for a programme of activities. The preparation of a list of native species of potential usefulness for enhancing fish yield of various inland waterbodies in the region is the first step in this direction which has already been initiated. The Working Party may also wish to consider whether the Code of Practice to reduce the risk of adverse effects arising from the introduction or transfer of inland aquatic organisms which has been already adopted by EIFAC and ICES member countries to serve as guidelines for the consideration of any new candidate species of fish for introduction into the inland waters of Europe and North Atlantic, is required in the IPFC member countries and if so, what form it should take. The special requirement for fish transfers by island countries and major Pacific islands, poor in indigenous inland fish species, should be taken into consideration.

ANNEX H

THE EIFAC CODE OF PRACTICE

(As adopted by the Fourteenth Session of EIFAC
Bordeaux, 27 May-3 June 1986)

Code of Practice to reduce the risk of adverse effects arising from the introduction or transfer of inland aquatic organisms.

(a) Recommended procedure prior to reaching a decision regarding proposed introductions

(This procedure does not apply to introductions or transfers which are part of current commercial practice).

(i) Member countries contemplating any introduction should be requested to present to EIFAC at an early stage information on the species, area of origin, proposed place of introduction and objectives, with such information on its habitat, associated organisms, etc., as is available. EIFAC should then consider the possible outcome of the introduction and offer advice whether to proceed with further evaluation.

(ii) Appropriate authorities of the importing country should examine each "candidate for admission" to assess the justification for the introduction, its relationship with other members of the ecosystem, details of its biology and ecology and the possibility of introducing associated pathogenic organisms and parasites.

(iii) The probable effects of introduction into the new area should be assessed carefully, including an examination of the effects of any previous introductions of this or similar species in other areas, and a prediction of the final range of the species assuming it could form breeding populations in natural waters.

(iv) As an aid, the above procedures (i, ii, iii) should be carried out by following the Review and Decision Model as set out in the subsequent section.

(b) Recommended action

If the decision is taken to proceed with the introduction, the following action is recommended:

(i) A brood stock should be established in an approved quarantine situation. Brood stocks should be developed from stocks imported as eggs, in order to minimize the possibility of contamination by pathogenic organisms, parasites or by other species of fish. All effluents from establishments used for quarantine purposes should be sterilized in an approved manner.

(ii) If no communicable pathogenic organisms including parasites become evident, the first generation progeny, but not the original import, of the introduced species can be transplanted to culture sites, or to the natural environment, preferably to small, isolated and restricted river basins or lakes.

(c) Recommended actions after introduction:

(i) A continuing study should be made of the introduced species in its new environment and progress reports submitted to EIFAC.

(ii) Every effort should be made to contain the species within the water bodies or water courses into which introduction was intended.

(d) Regulatory agencies of all member countries are encouraged to use the strongest possible measures to prevent unauthorized or unapproved introductions and transfers:

(e) Recommended procedure for introductions or transfers which are part of current commercial practice:

The procedure laid down by the "Draft Convention to prevent the spread of major communicable fish diseases" should be adhered to, especially:

(i) Periodic inspection (including adequate microscopic and microbiological examinations) by the receiving country of material for prior mass transplantation to confirm freedom from introduceable pests and diseases. If inspection reveals any undesirable development, importation must be immediately discontinued. Findings and remedial actions should be reported to EIFAC.

(ii) Inspection and control of each consignment on arrival.

(iii) Quarantining or disinfection where appropriate.

(iv) Establishment of brood stocks certified free of specified pathogens.

(f) Definitions pertaining to the Proposed Code of Practice

For the application of this Code, the following definitions should be used:

(i) Introduced species (= non-indigenous species; includes both non-indigenous and exotic species): Any species intentionally or accidentally transported and released by man into an environment outside its present range.

(ii) Transferred species (= transplanted species): Any species intentionally or accidentally transported and released within its present range.

(iii) Quarantined species: Any species held in a confined or enclosed system that is designed to prevent any possibility of the release of the species or any of its diseases or any other associated organism into the environment.

(iv) Exporting country: The country from which a specific consignment of a species (regardless of its native region) is received.

(v) Country of origin: The country where the species is native.

(vi) Country of receipt (= importing country): The country to which a specific consignment of a species is sent for introduction, transfer (in the sense of (ii) or quarantine.

(vii) Brood stock: Specimens of a species, either as eggs, juveniles or adults, from which a first or subsequent generation may be produced for possible introduction or transfer.

(viii) Current commercial practice: Established and ongoing cultivation, rearing or placement of an introduced or transferred species in the environment for economic or recreational purposes.

ANNEX I

PAPERS SUBMITTED TO THE WORKSHOP ON STRATEGIES FOR THE MANAGEMENT OF FISHERIES AND AQUACULTURE IN MANGROVE ECOSYSTEMS

LIST OF PAPERS

Introductory papers

Asia and Pacific regional mangrove activities; Integrated management of mangroves, by Dr. Sanit Aksornkoae

Mangroves, fisheries and aquaculture, by Dr. J.M. Kapetsky

Management problems and management solutions

Management of fisheries and aquaculture in mangrove ecosystems in Australia, by Mr. B.R. Pollock

Effects of shrimp farming and other impacts on mangroves of Bangladesh by Dr. Nuruddin Mahmood

Management of mangrove associated fisheries and aquaculture in the sunderbans, India, by Dr. E.G. Silas

Management strategies for fisheries and aquaculture in mangrove ecosystems, by Dr. A.Q. Chowdhury

Development of aquaculture in mangrove areas and its relationship to the mangrove ecosystem, by Dr. F. Cholik and Dr. A. Poernomo

Ecological research needs in relation to the impacts of various uses on the mangrove ecosystems of the Indo-Pacific region, by Dr. Ong Jin-Eong*

Utilization and management of mangrove resources, by Mr. R.S. Jara

Fisheries and aquaculture in lagoons, estuaries and mangroves in the context of coastal zone management in Sri Lanka, by Dr. J.I. Samarakoon

Management of fisheries and aquaculture in mangroves in Thailand, by Mr. M. Potaros

Restoration of mangroves and seagrasses and economic benefits for fisheries and mariculture, management, policy and planning, by Dr. A. Thorhaug

Management strategies for fisheries and aquaculture in mangrove ecosystems in Sri Lanka, by Mr. A.M. Jayasekara

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* Unable to attend: paper summarized by Dr. J.M. Kapetsky

M-44
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